OCTOBER 2017

Military & Aerospace Electronics

ENABLING TECHNOLOGIES FOR NATIONAL DEFENSE

New paradigm in naval warfare

It could be as significant as the battleship and the aircraft carrier. PAGE 2

Unmanned sensor processing

Pushing the bounds of SWaP for rugged processing aboard military unmanned vehicles. PAGE 20

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Border and perimeter security

Sensors, data processing, and wireless networking secure the nation's borders. PAGE 10

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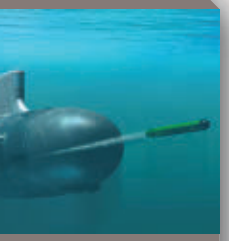

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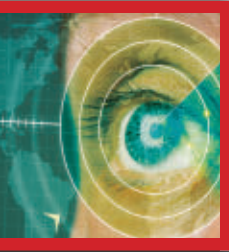

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BY **JOHN KELLER**, EDITOR IN CHIEF

Get ready for a new era in naval warfare

We may be on the precipice of a major shift in naval warfare that is every bit as disruptive and significant as the armored battleship and submarine in World War I, and the aircraft carrier in World War II.

The idea revolves around real-time secure networks of manned and unmanned aircraft, surface ships, and submarines able to attack and defend vast areas of the world's oceans to hold enemy ships and submarines at risk over wide contested areas. This is the core concept of the Cross Domain Maritime Surveillance and Targeting (CDMaST) Phase 2 project of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va. It could lead to a new era of global sea control, and could be a fundamental step forward in maritime combat.

CDMaST would augment aircraft carrier battle groups and manned submarines with networked manned and unmanned systems of systems (SoS) that work collaboratively to control the seas. This approach has the potential to render previous forms of naval warfare obsolete.

The advent of shipboard nuclear power in the 1950s leads us to today's most modern aircraft carriers, fast attack submarines, and ballistic missile submarines that can operate for years without refueling. These vessels have been kings of the ocean now for nearly 60 years. Everything changes, however, and it's unlikely that nuclear-powered aircraft carriers and submarines will remain the centerpieces of naval power.

U.S. sea-control today revolves around carrier battle groups and nuclear submarines. Basing the Navy's survival on these assets, however, increasingly is difficult because of the many enemy long-range anti-ship missiles they face. Adversaries also are quickly enhancing their anti-submarine warfare capabilities.

To overcome these obstacles, the CDMaST program seeks to move away from a centralized defensive battle group posture to a more distributed and agile approach to hold the opponent at risk over ocean areas as large as a million square kilometers.

Think of it: The Navy no longer would have to base its global strategy on 12 aircraft carriers, 52 attack submarines, and 18 ballistic- and cruise-missile submarines. Instead, the heart of U.S. naval power would be rapidly reconfigurable forces of size and scope to meet specific challenges when and where they are needed most.

The concept is to distribute combat ability across many low-cost systems to threaten the opponent and put him on the defensive. This will involve a combination of manned and unmanned systems to form SoS architectures able to conduct wide-area surveillance and targeting, and cause the opponent to expend resources trying to defeat the low-cost systems.

Today's aircraft carriers and nuclear submarines would become platforms for deploying manned and unmanned surveillance and strike assets. Meanwhile, they would retain their offensive and human leadership capabilities. These expensive vessels wouldn't have to operate close to the enemy; instead they would send their unmanned systems to do that in the air, on the water, and under the surface. It's doing more with less.

Such a future naval strategy also would use pre-deployed hidden sensors and weapons like those envisioned in the DARPA Upward Falling Payloads program. DARPA researchers are considering networked systems of new anti-ship missiles; fast, long-range undersea weapon systems; unmanned, long-endurance air, surface, and undersea vehicles; and prepositioned seafloor systems. Combined with manned platforms, these systems can provide the surveillance and targeting needed to exploit new weapons.

New technologies would come to bear in communications; battle management; command and control; position, navigation, and timing; logistics; sensors; manned and unmanned systems; and weapons.

It's a new day for which we should prepare ourselves. The era of distributed networked naval systems is not far off.

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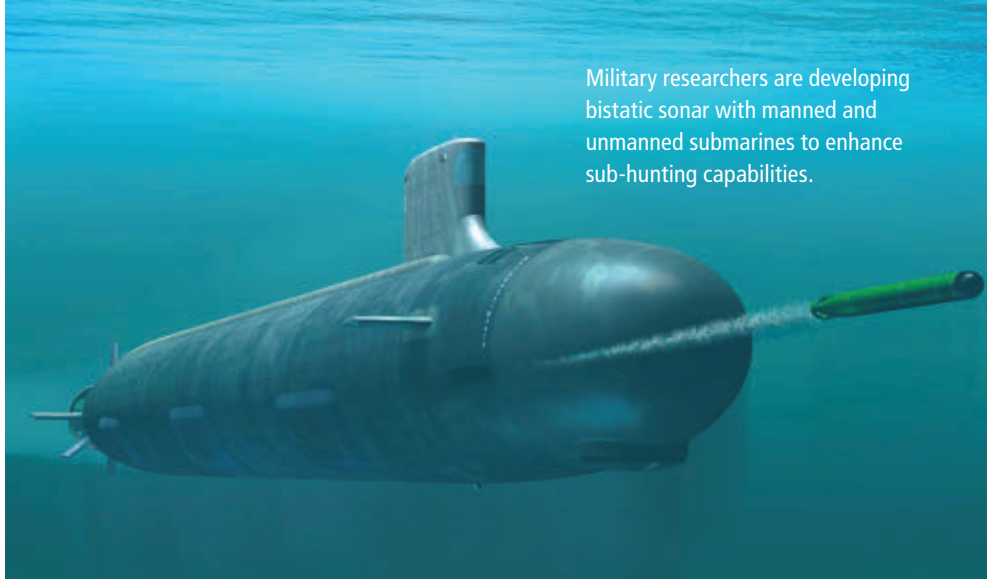
news

IN BRIEF

Raytheon to build lightweight Griffin missile for UAVs, surface warships, and aircraft

U.S. Air Force airborne weapons experts are asking the Raytheon Co. to build a lightweight missile and glide bomb that features low collateral damage and is suitable for launch from a variety of unmanned aerial vehicles (UAVs), military manned aircraft, and surface warships. The Air Force announced a $104.9 million contract to the Raytheon Missile Systems segment in Tucson, Ariz., to build, test, and support the AGM-176 Griffin missile. Griffin is a lightweight, precision-guided munition that can launch from the ground, from the air as a rocket-powered missile, or drop from the air as a guided bomb. It carries a relatively small, 13-pound warhead for low-collateral damage, as well as for use in irregular warfare. The munition comes in two versions. Griffin A is an unpowered precision munition that can be dropped by aircraft from a rear cargo door or a door-mounted launcher. Griffin Block II B is a short-range missile that can be fired from UAVs as well as manned helicopters, attack aircraft, U.S. Air Force AC-130W gunships, and U.S. Marine Corps KC-130J tankers.



Military researchers are developing bistatic sonar with manned and unmanned submarines to enhance sub-hunting capabilities.

New era dawns in ASW as manned and unmanned submarines team for bistatic sonar

BY JOHN KELLER

NEWPORT, R.I. — U.S. military researchers are asking two U.S. defense contractors to develop bistatic sonar for anti-submarine warfare (ASW) that teams manned and unmanned submarines and capitalizes on the benefits of active sonar without compromising the stealth of U.S. attack submarines.

Officials of the U.S. Naval Undersea Warfare Center (NUWC) in Newport, R.I., have announced a $4.6 million contract to the BAE Systems Electronic Systems segment in Merrimack, N.H.; and a $4.7 million contract to Applied Physical Sciences Corp. in Groton, Conn., for the Mobile Offboard Command and Control and Approach (MOCCA) program.

NUWC awarded the contracts in February on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va. MOCCA seeks to enable manned Navy submarines to use active sonar pings from nearby unmanned underwater vehicles (UUVs) to detect and track enemy submarines at long ranges without giving away their presence to potentially hostile vessels.

The project seeks to use UUVs as pingers and manned fast attack submarines as listeners to conceal the presence of the manned attack sub. Using this technology, the manned submarine could detect and target enemy submarines based on sonar returns from the UUV active sonar pingers.

Traditional active sonar bounces sound waves off submarines, surface warships, and other objects for detection and tracking. The problem with active sonar, however, is it's like shining a flashlight in a darkened room: It can find objects effectively, but gives away its presence and forfeits any pretense of stealth.

Passive sonar, on the other hand, simply listens for sounds from enemy submarines or surface ships. It's not as effective or as efficient as active sonar, but it preserves stealth and can keep the submarine's presence secret from the enemy.

Bistatic sonar using sonar transmitters aboard a UUV and sonar receivers aboard nearby attack submarines, however, has the potential to gain the best of both worlds.

As long as attack submarine crews have precise knowledge of the position of the pinging UUV, they can detect the presence of enemy submarines based on sonar sound returns, and track their movements with accuracy. Moreover, attack submarines can keep their locations secret — if the enemy submarines don't inadvertently receive acoustic signal returns from the attack submarines.

The DARPA MOCCA program seeks to develop active sonar solutions that will mitigate the limits of passive submarine sonar sensors, researchers say. The objective is to achieve significant standoff detection and tracking range by using an active sonar projector deployed offboard a submarine and onboard a UUV.

The submarine will need the ability to coordinate the operational functions of the supporting UUV. Thus, the program must demonstrate reliable clandestine communications between the host submarine and supporting UUV without sacrificing stealth.

The program is asking BAE Systems and Applied Physical Sciences to develop compact active sonar sources, signal processing, and secure undersea communications technology for an offboard UUV in support of ASW.

The first phase will last for 15 months and will involve preliminary designs for innovative sonar and communications concepts, as well as subsystem prototype demonstrations to validate design approaches.

The MOCCA program has two key technical challenges: an active sonar pinger small enough for UUVs, as well as signal processing, and a secure communications link to enable the host submarine to control the UUV at significant distances.

DARPA researchers are asking the two companies to build an active sonar with an active sonar projector small enough for UUV operations, and bistatic active sonar processing. This will involve developing high-output transducer materials, and a sonar projector that is as energy-efficient as possible.

Researchers want the ability to focus the projected acoustic signal in a direction of interest. The goal is to produce practical and flexible designs for the projector that can scale for several different UUVs and deployment options.

IN BRIEF

Lockheed Martin to upgrade avionics and computers on German P-3C aircraft

Military avionics experts at Lockheed Martin Corp. will upgrade the mission computers aboard German military P-3C maritime patrol and anti-submarine warfare (ASW) aircraft under terms of a $158.5 million order. Lockheed Martin Global Inc. in Owego, N.Y., will upgrade the mission computers, acoustic equipment, armament/ordnance systems, and displays and controls on eight German P-3C aircraft under the Foreign Military Sales (FMS) program. The Lockheed Martin P-3C Orion four-engine turboprop long-range maritime patrol plane has been in service since 1969, and is a converted version of the Lockheed Electra passenger aircraft. The Navy P-3C is being replaced by the Boeing P-8A Poseidon jet. This contract modification to Lockheed Martin will provide for new mission and acoustic system avionics with several German-specific components to satisfy current and future North Atlantic Treaty Organization (NATO) requirements. The P-3C is designed for missions that include long-range ASW patrol, as well as land and sea surveillance. It has

In addition to a small, power-efficient sonar projector, or pinger, researchers are asking the two companies to develop bistatic sonar processing advancements in reverberation and clutter rejection as well as precision localization capability. The host UUV is expected to be no larger than 21 inches in diameter.

The goal is to operate the system in bottom-limited acoustic environments, so projected sound will scatter and produce reverberation and signal loss. Scattered sound inadvertently may illuminate the host submarine and possibly compromise stealth, so researchers want detailed and accurate predictions of the acoustic environment to manage the sonar and potential exposures.

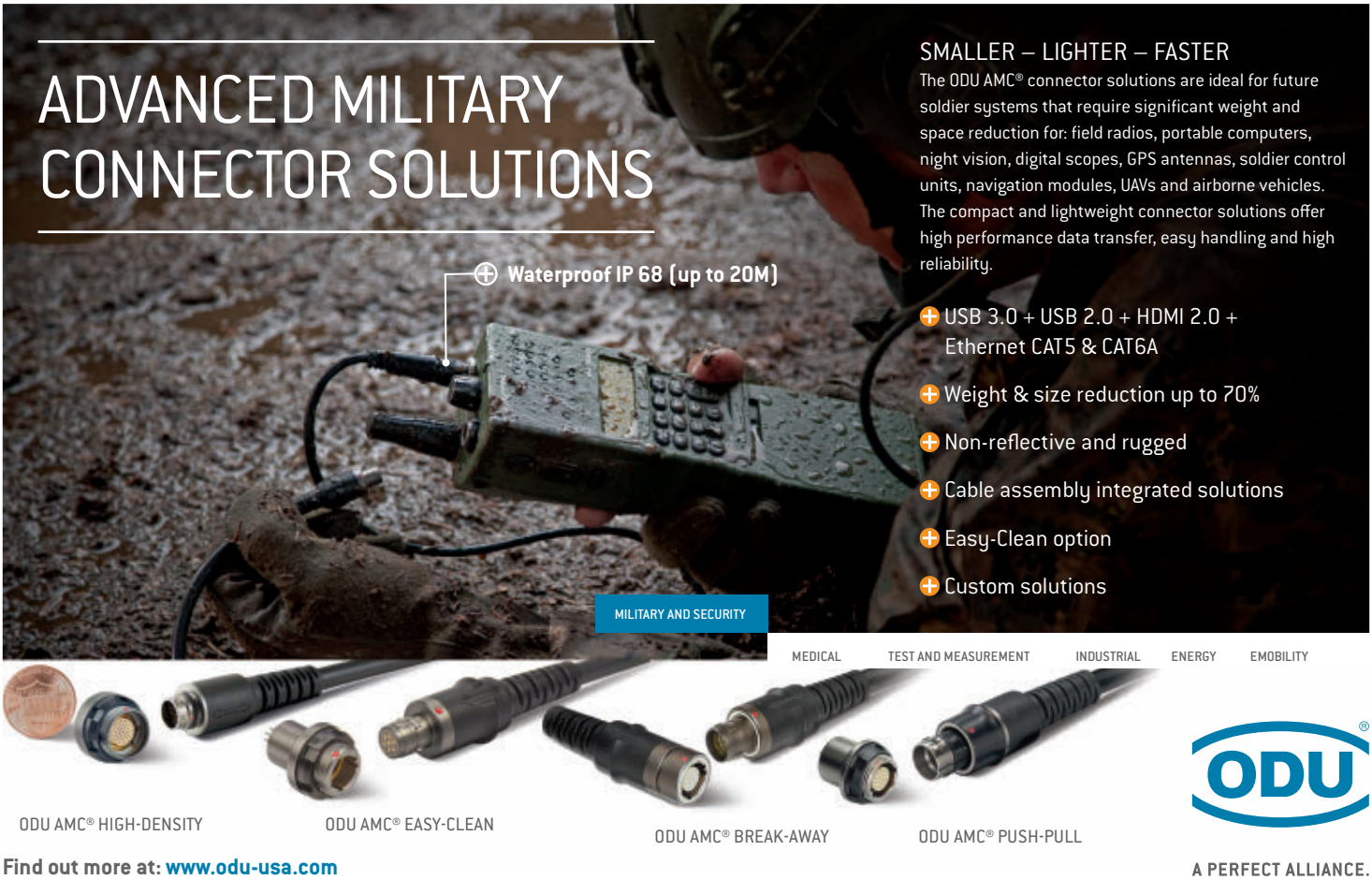
Researchers also need a secure and reliable communications link to provide positive control of a UUV and its sonar payload operating at a significant distance from its host submarine. The communications link also must be able to communicate information generated on the UUV back to the host platform.

An ideal link would have a low probability of intercept and of exploitation and provide high link reliability. The MOCCA communications link cannot degrade submarine stealth.

FOR MORE INFORMATION visit **BAE Systems Electronic** systems online at *www.baesystems.com*, **Applied Physical Sciences** at *www.aphysci.com*, and **DARPA** at *www.darpa.mil*.

Navy eyes technologies in mine warfare, special ops, and expeditionary warfare

U.S. Navy surface warfare experts are reaching out to industry for enabling technologies to enhance or speed new military capabilities in mine warfare, naval special operations, and naval expeditionary warfare. Researchers at Naval Sea Systems Command in Washington issued a solicitation (N00024-17-R-6271) for the Confronting Irregular and Expeditionary Warfare Capability Challenges project to develop new technologies in mine warfare, naval special warfare, and naval expeditionary combat that apply to Navy programs of record or



IN BRIEF

advanced submarine-detection sensors, such as directional frequency and ranging (DIFAR) sonobuoys and magnetic anomaly detection (MAD) equipment.

Radiation-hardened embedded computer from BAE Systems ready to serve in space

Aerospace and defense technology company BAE Systems in Manassas, Va., is debuting its next-generation hardened computer designed for space-based use. The new RAD5545 single-board computer beats its predecessor in size, speed, and efficiency, BAE systems says. The new space microprocessor is radiation-hardened against ambient radiation, which means it can work reliably in the challenging conditions of outer space for protracted periods. The RAD5545 is designed to be simpler than computers used on previous generations of space-faring vehicles and satellites, since it replaces multiple cards with just one. It can also unlock new capabilities for future spacecraft, including encryption, running multiple operating systems at once, processing extremely high-resolution images, and autonomously operating spacecraft. Each of these tasks was beyond the capabilities of previous single-board computers designed for space.

other acquisition programs. Navy researchers are interested in new technologies that could be ready within one year, based on prototype demonstrations in realistic environments. Those interested have one year to submit ideas. Capabilities of interest involve reconnaissance, counter-terrorism, direct action, irregular warfare, foreign internal defense, and other urgent and emerging needs in mine warfare, special warfare, and expeditionary combat. In addition, the Navy wants new technologies that enable warfighters to operate in harbors, rivers, bays, and on beaches, as well as technologies that improve access to multi-intelligence, surveillance, and reconnaissance at the tactical edge.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/DON/NAVSEA/NAVSEAHQ/N00024-17-R-6271/listing.html*.

Air Force asks industry for space communications to track and control multiple satellites

BY JOHN KELLER

LOS ANGELES AFB, Calif. – U.S. Air Force space experts are reaching out to industry for communications technologies able to contact multiple satellites and other spacecraft simultaneously across several frequency bands to track and control a growing number of space vehicles in Earth orbit.

Officials of the Air Force Space and Missile Systems Center (SMC) at Los Angeles Air Force Base, Calif., have issued a request for information (FA8806RFI01) for the Multi-Band Multi-Mission Systems — Multi-Band Multi-Mission project.

A multi-band, multi-mission system could help the Air Force deal with the growing number of orbiting U.S. government satellites, and may augment or replace the current Air Force Satellite Control Network (AFSCN) and Launch and Test Range System (LTRS) infrastructure.

The Air Force is looking for new ways of controlling several different satellites at once to track and control a growing number of space vehicles in Earth orbit.

A future multi-band, multi-mission, space-control system could perform key telemetry, tracking, and control (TT&C) capabilities and radar functions, Air Force officials say.

Air Force space-control

experts say they need to increase capacity, flexibility, interoperability, automation, and resiliency of space operations and spacelift because of the increasing number of satellites and space launches expected in the future.

A multi-band, multi-mission system should be able to contact several space vehicles simultaneously across several frequency bands and provide tracking radar to support the Air Force AFSCN and LTRS.

Air Force officials are asking industry for information on today's available capabilities that companies could demonstrate with hardware in action. These capabilities should be able to meet the needs of the Multi-Band Multi-Mission Systems — Multi-Band Multi-Mission project now, or be modified to do so in the future.

Candidate technologies should be able to respond to a surge in demand for spacecraft tracking and control; support frequency bands such as VHF, UHF, C, L, S. K, Q, and X; communicate with spacecraft from low-Earth orbit to geosynchronous orbit, as well as launch and early orbit; be able to receive and distribute several telemetry and ranging downlinks and uplinks; operate on cloud-based computing; and monitor telemetry of several satellites simultaneously around the clock.

From companies that have suitable technologies, the Air Force wants to know how many simultaneous contacts, uplinks, and downlinks they can support; frequency bands supported; viewing and scan angles; data rates and modulation types; timelines to demonstrations; data rights and licensing needed; technology maturity levels; and available documentation.

Companies interested should e-mail responses no longer than 25 pages in Microsoft Word or .pdf formats to the Air Force's Jeffrey Dedrick at Jeffrey.Dedrick@us.af.mil. E-mail questions or concerns to Jeffrey Dedrick at Jeffrey.Dedrick@us.af.mil, Rachel Scollans at Rachel.Scollans@us.af.mil, or Capt. Alexander Bast at Alexander.Bast.1@us.af.mil.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/USAF/AFSC/SMCSMSC/FA8806RFI01/listing.html*.

TECHNOLOGY FOR BORDER AND PERIMETER SECURITY

BY J.R. WILSON

Sensors, data processing, interoperability, open systems, and wireless networking are only a few of the enabling technologies for securing the nation's borders and critical infrastructure.

Refugees and immigrants, legal and illegal, are moving across the globe in numbers not seen since World War II, stressing the politics and security capabilities of dozens of nations. While this phenomenon has been divisive and costly, it is not something upper tier nations were unable to handle previously, even if it took a generation or two to fully assimilate the new population segments.

Today, however, an already complicated issue has been made more complex — and potentially devastating — to the target nations by the presence of far more criminals and terrorists, some from well-organized and -funded organizations, some "freelance" fanatics, but all carrying the potential for violence and chaos.

The situation has grown beyond the capabilities of traditional human and dog patrols, official manned checkpoints at borders, seaports, and airports, and coastal water patrols. The reaction by individual nations across the world has ranged from significantly raising the level of vetting new arrivals to increasing security checks at official entry points, adding more border patrols, limiting the number of new arrivals allowed, or trying to close their borders to all new immigrants.

The problem is especially acute for the United States, whose only two land borders include the world's longest with Canada (5,500 miles) and nearly 2,000 miles with Mexico — both largely desolate —

plus 95,000 miles of shoreline, 15,000 airports, and government and military facilities in nearly every nation on Earth.

"The simple issue of building a physical versus a smart barrier, where 21st Century technologies are used, is a battle that has just begun," Nelson Balido, CEO, Border Commerce & Security Council, said in an interview with Institute for Defense & Government Advancement (IDGA) before its 2017 Homeland Security Week conference.

"Local and state issues must be taken into consideration, private land owners will certainly have skin in the game, as will various other groups," Balido said. "In the end, we need solutions that give our front-line agents a force-multiplier effect to keep everyone safe and accomplish the mission."

Standardized processes

What border security authorities also need are standardized processes for surveillance and reconnaissance, says Emily Keplar, intelligence functional manager at the U.S. Department of Homeland Security (DHS) in Washington, who oversees intelligence collection and reporting.

The DHS needs ways to establish multi-layered intelligence, surveillance, and reconnaissance (ISR) plans that align resources and command structures to synchronize DHS activities, Keplar says.

"We have to provide timely intelligence to our DHS components and our federal, state, local, and tribal partners, allowing a proactive approach rather than strictly a reactive approach to threats," Keplar says. "Infrastructure and architecture will be key to generating actionable intelligence. Ensuring we have proper connectivity to sensors, customers, and decision-makers is critical... Finding new solutions and sharing existing resources is becoming more necessary."

The DHS Silicon Valley Innovation Program — a partnership of high-tech industry, DHS Science & Technology (S&T), and Customs and Border Protection (CBP) — is working to enhance the situational awareness of Border Patrol agents who often operate in harsh terrain under extreme physical conditions,

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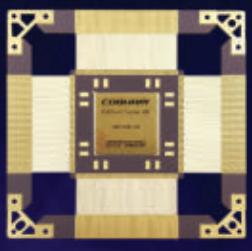

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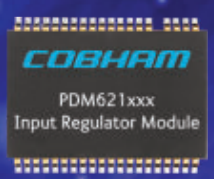

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Border security is a hotbed of new technologies, but sometimes the best solutions have been in use for hundreds of years, as Border Patrol agents still rely on horses for use in difficult terrain.

with backup often miles away. In an April 2017 Customs and Border Protection blog entry, Commissioner Kevin K. McAleenan wrote that one of the most successful initiatives under the program involves small unmanned aerial vehicles (UAVs).

"Developing technologies and capabilities to secure our hardware and software platforms is critical for deploying SUAS [small unmanned aircraft system] technology," McAleenan wrote. "We have been looking for technologies that will help adapt SUAS platforms for use in Customs and Border Protection, and specifically border patrol missions, such as new sensors, user interfaces for law enforcement officers, and cybersecurity.

"We have received a number of proposals from quality companies who have applied for the program and we view this interest, and the success of these companies thus far, as a sign of great things to come with respect to Customs and Border Protection and S&T's collaborative efforts with the technology community," McAleenan added.

Advances in technology in the 21st Century's first two decades have resulted in smaller, lighter, faster, more capable, and more mobile platforms, sensor fusion, data analysis, and automatic targeted distribution.

"The technologies are a mixture of things that have advanced, in some cases, slower than the commercial industry, which has been pushed by smartphones," says Keith Riser, an identity intelligence engineer at the U.S. Army Communications-Electronics Research, Development & Engineering Center (CERDEC) at Aberdeen Proving Ground, Md.

Biometrics

"In the U.S. Department of Defense (DOD), the focus has been on fingerprints and imperfect environments," Riser says. "We're looking to move toward more commercial sensors in the future. Mobile devices that adhere to the same set of standards open a larger set of devices that can be used by the DOD. Fingerprints, eyes, face are the primary uses now." Riser is part of CERDEC's Intelligence & Information Warfare Directorate's Intelligence, Surveillance, Reconnaissance & Targeting (ISRT) activity.

ISRT's fielded technologies to

help warfighters secure borders, checkpoints, and U.S. military and government facilities overseas include Tactical Reconnaissance & Counter-concealment Enabled Radar (TRACER); Vehicle and Dismount Enabled Radar (VADER); Wolfhound Handheld Threat Warning System; Vigilant Pursuit; and Distributed Common Ground System–Army (DCGS-A).

TRACER enables long-range, wide area detection of targets under camouflage, concealment, and deception conditions and mapping for complex environments. It enhances situational awareness by detecting small roadside targets and buried weapons caches through onboard image formation and change detection.

VADER is an advanced Ku-band ground moving target indicator radar that can detect and track moving vehicles and pedestrians. It also can provide wide- and small-area air-to-ground moving target indication, high-range resolution target scanning, real-time (or forensic analysis) detection of large numbers of targets, and synthetic aperture radar (SAR) imaging of fixed targets.

Upgraded Remote Video Surveillance System sensors are taking their place in U.S. border security.

Wolfhound fills coverage gaps and other limitations of traditional systems through frequency threat and direction finding. The handheld device enables warfighters to geo-locate spotter positions and observation posts.

Vigilant Pursuit combines human intelligence and signals intelligence from any source. Its information helps soldiers identify persons of interest and uses cross-cuing and tipping to help with decision-making in the field. It hosts DCGS-A workstations, dismounted human intelligence collection, and several National Security Agency (NSA)

enterprise solutions. DCGS-A is the Army's primary system for posting data, processing information, and disseminating ISR information.

While not developed specifically for border security or immigration control, each of those systems can be applied to elements of the Army's overseas missions in both areas. They also could be modified for use by DHS in patrolling U.S. land borders, shorelines, official ports of entry, and coastal waters.

Dual-use technologies

ISRT research programs look at how sensors can share biometric data. How CERDEC and DHS interact in this effort can be seen in the Automated Biometric Identification System — called ABIS by the military, IDENT by DHS.

Both provide centralized, system-wide storage and processing of biometric and associated biographic information for national security, immigration and border management, and intelligence and background investigations.

"You first take an individual's fingerprints and eye scans, which enrolls them in IDENT, says CERDEC's Riser. "The goal is to have an authoritative response within three minutes. Another aspect is a watch list on the devices themselves. These can provide a lot of nuances indicating why the individual is there.

"These basically offer a passive defense. If you can identify someone who has malicious intent before they cross a perimeter, you can detain them for further screening. That improves soldier safety without targeting an entire group," Riser says.

DHS is converting the 20-year-old Remote Video Surveillance System (RVSS) sensor towers into hosts for an improved RVSS developed by General Dynamics Information Technology in Fairfax, Va. As part of that program for Customs and Border Protection, General Dynamics also developed and is field-testing a mobile, relocatable version called R-RVSS.

"We were able to bring a modern, current system that updates electro-optical and infrared, but also includes a laser illuminator, spotlight, a loud hailer, all as integrated components," says Robert Gilbert, senior program director at General Dynamics Information Technology. Gilbert is a retired chief of the Customs and Border Protection agency.

"The operator in the command center can click the mike and tell people what to do, including warning an agent of someone he may not see," Gilbert says. "It significantly reduces the time agents previously wasted responding to false alarms. The system also can see into Mexico, giving Border Patrol field leadership knowledge they did not have before so they can deploy their human assets where they are most needed. It is a phenomenal deterrent. Anyone looking at crossing the border illegally or smuggling drugs can see these systems and know they are being observed."

Unmanned ground vehicles are taking a role in border and perimeter security to block drug smugglers and other intruders.

Upgrading legacy systems

There also are legacy RVSS installations on the U.S. border with Canada. Gilbert says he expects that expanding the use of RVSS on the U.S. and Canadian border will replicate what is being done on the Southwest border — upgrading legacy installations and expanding into new areas as they update their requirements.

The stationary RVSS is mounted on towers, poles. Upgrades are in progress on 70 sites in Arizona and 80 in Texas. The R-RVSS uses a retractable mast as high as 80

Border Patrol agents for decades have relied on sensor towers, yet these are giving way to networks of fixed and mobile sensors for enhanced situational awareness.

feet mounted on self-sustaining trailers that can run for as long as 45 days, and then change locations in less than a day.

General Dynamics also has installed a pilot Law Enforcement Application Platform (LEAP) at Los Angeles International Airport. LEAP is designed to detect perimeter intrusions along the airport's fence line. Its components and sensors correlate with more than 3,000 cameras that General Dynamics is deploying throughout the massive facility. Gilbert believes LEAP also may be of interest to the Border Patrol.

"The primary application we've been looking at, especially in airports, is facial recognition," says Peter Howard, senior business development director at General Dynamics Information Technology. "We also have License Plate Recognition (LPR) technology, which we look at as enhancements to the video system. We can bring in a number of sensors in a common operating picture."

Customs and Border Protection is demonstrating facial recognition exit technology at five high-traffic

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Federal authorities are converting the 20-year-old Remote Video Surveillance System (RVSS) sensor towers into hosts for an improved RVSS system.

U.S. airports and is collaborating with airlines to integrate facial recognition technology into passenger gates at three others. The agency notes there are several laws directing DHS to record the arrival and departure of non-U.S. citizens.

"You never know what new and cool technology is starting to emerge and the potential for that technology to be integrated into the immigration process," says Paul Hunter, chief of biometrics strategy at DHS U.S. Citizenship & Immigration Services (USCIS). Hunter made his comments in an interview with IDGA prior to the July 2017 Biometrics for Government & Law Enforcement International conference.

"Voice holds a lot of promise in the digital age," Hunter says. "Facial recognition holds huge potential to improve and eliminate face-to-face interaction with the government. Person-centric processing versus form-based is the next leap in transformation."

IDENT, developed in the 1990s, will be replaced by a new system, Homeland Advanced Recognition Technology (HART), to handle the growth of stored biometric identities, says Shonnie Lyon, acting director of the DHS Office of Biometric Identity Management. The number of biometric identities has risen from hundreds of thousands initially to more than 200 million.

"HART will deliver more robust performance, greater capacity and functionality, and multi-modal matching, storing, and sharing capabilities," Lyon said in an accompanying interview. "Another challenge is the pace of change in the biometrics and identity space. Technological advances and customer demands are moving so quickly that, in many cases, an overall policy framework has not yet been developed."

Safeguarding privacy

An additional challenge relates to balancing privacy and mission needs, Lyon explains. "Privacy protection is of utmost importance. Balancing the natural tension between a commitment to privacy protection and the need to exchange biometric data means we need to be especially vigilant in what data is shared and with whom."

Several technologies are in the works to enhance the speed, accuracy, and safety of border security. Those include palm prints, DNA, gait, space between the eyes, license plate recognition, and vehicle detection and tracking.

Palm prints can be lifted from bombs or fragments, and can be stored in IDENT. Federal experts still are considering how to tie DNA into their processes for screening refugees and immigrants in border operations, identifying family lines, and augmenting existing forensic processes. DNA is expected to have a much more significant role in the next five to ten years.

Gait, or how someone walks, is unique. A gait that differs significantly from the norm may indicate a suspect is carrying a heavy or dangerous load. Micro-expressions and Interocular Distance (space between the eyes) could benefit down the road. License plate recognition and vehicle detection and tracking could help resolve any questions before a suspect is close to human guards. LPR is more common in the U.S.

"Any of those new modalities require creating ways to collect and store them on the database, then put into the watch list, and match them in real time," CERDEC's Riser says. "We're definitely looking at data collection and dissemination from any platform, but we also want to move processing into the cloud, so the collection device is agnostic. The goal remains providing a rapid response following data collection."

Another CERDEC directorate, Night Vision & Electronic Sensors (NVESD) at Fort Belvoir, Va., established a counter-terrorism branch shortly after 9/11 to develop electro-optical threat sensors. Their current focus is on perimeter security.

"We began working about 10 years ago with DHS on joint urgent operational requirements called Base Expeditionary Targeting Surveillance Systems–Combined (BETSS-C)," says Len Ramboyong, chief of the NVESD Counter-Terrorism Branch. "That resulted in a group of force protection equipment used for perimeter security. Part of that suite was a system called Cerberus, consisting of visual and infrared imaging, unattended ground sensors, and radars to detect targets."

A major drawback with BETSS-C was the inability of five or six of its different systems to talk to each other. Each had to have its own operator sending information into a technical operations center to make sense of the different inputs. That led to a real push for interoperability in the systems CERDEC developed later.

Resolution and deployability

"We are working on enhancements that will go into the Ground-Based Operational Surveillance System-Expeditionary (GBOSS-E) to meet a new requirement for better resolution and be more deployable, so they can be moved easily without a large logistic footprint," Ramboyong says. "We're working on sensor resolution, improving

processing speed, and algorithm development that will allow us to more quickly identify targets, bring in some automation, and reduce operator reaction time, while enabling better sharing of information by making the systems more interoperable."

NVESD is developing on systems to increase stand-off capabilities and enable users to detect individuals and vehicles at longer distances. Processing and resolution enhancements will enable faster detection of anomalies, with some of the detection capabilities becoming more automated. That does not include the use of artificial intelligence (AI), Ramboyong adds, which, while potentially helpful, is still too early in development.

"There are a lot of different AI technologies, so we have to identify the proper one for each application, given the environment and mission, finding something that will enhance, rather than hinder, the system," agrees Gilbert of General Dynamics. "When you integrate technology, if you haven't done due diligence, you may create problems you didn't have before, so you have to make sure any improvement is an actual improvement. At this point, we're not yet ready to deploy AI."

Cybersecurity

As is true throughout electronic high-tech, these systems will be targeted by hackers. This has placed ever-higher requirements on network and system security.

"Everything is moving from wired to wireless connections," points out Chris Collura, sales director in the federal sector of Ruckus Wireless Inc. in Sunnyvale, Calif. "New security technology doesn't work if it isn't simple to expand and deploy in a world where all our tools are needed everywhere, all the time. If I need to move a checkpoint, even if just to the other side of an airport, the only way to do that quickly is with a wireless network.

"We have security mechanisms to allow different devices to connect only to the right networks," Collura says. "Next-generation security is not only for mobile phones, but also to ensure sensors are on the right network and no one else can connect with them. Bandwidth and reliability, in general, have advanced to give wireless connections comparable capability to wired, which was impossible just five years ago. That has been a game-changer."

Wireless networks and miniaturization of power and sensors have allowed cameras to move away from buildings or even fixed locations and be mounted on UAVs, unmanned ground vehicles, aerostats, and possibly unmanned surface vessels. That increases the area covered and the amount of data gathered.

At the same time, the imposition of government standards to certify wired and wireless networks has become a key to cybersecurity.

"If something happens, next-gen, certificate-based security allows me to force something off the network and require it to re-authenticate," Collura says. "Having devices pre-authorized to join the network before deployment limits the ability of someone to interfere with those."

Technology advancements in security systems have been spectacular in the past few years, but also have increased the need to secure deployed technology, and prevent the use of "backdoors" in U.S. technology.

"The problem with miniaturization is whether the data remains with the sensor or is sent back," Collura says. "It's not just one or two devices now, either, but a lot of different sensors. One thing we're working on is different technology from Bluetooth to LTE to Wi-Fi to make a single, secure network managing all that."

All the technologies for border and perimeter security are designed to increase speed, accuracy, and safety in dealing with millions of people on the move worldwide. They also raise numerous questions about privacy, system security, integration, and interoperability.

"Operating in gray areas is going to become more and more common," CERDEC's Riser says. "In the future, we are likely to be dealing with huge numbers of individuals, so having this capability in place now will help then because we won't have to target everyone.

"As we move forward, we will increase the speed and how we parse our sensing, increase partnering with industry and academia and leverage our subject matter experts to integrate all that knowledge," Riser says. "We want to make sure we aren't creating multiple stovepipes, so if we are developing something someone else also is developing, we can converge to solve both our needs without duplication." ←

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Micro data centers for military drones

Pushing the bounds of size, weight, and power consumption (SWaP) to design the most rugged and sophisticated on-board sensor and data processing for military unmanned air, land, and sea vehicles

BY **John Keller**

Demand is exploding for sensor capability aboard unmanned vehicles. To a large extent, these unmanned craft represent the eyes and ears of U.S. and allied military forces, and are becoming more so in the future. Top commanders rely on unmanned vehicles to get them the information they need, when they need it, with little or no time lag involved.

Unmanned vehicles also are shrinking in size. Where once the U.S. military relied exclusively on unmanned aerial vehicles (UAVs) the size of jet fighters, today's UAVs often have wing spans no longer than a person is tall and can be launched by catapult, and sometimes even by hand. This trend is continuing with development of UAVs small enough to fit in a warfighter's shirt pocket.

This creates unprecedented design challenges for the embedded computing industry, whose engineers increasingly are being asked to design what essentially are rugged, mobile micro data centers that are small, rugged, powerful, and power-efficient enough for duty aboard the latest generations of unmanned vehicles.

The A176 rugged embedded computer from Aitech Defense Systems has general-purpose graphics processing unit (GPGPU) functionality to provide real-time image recognition for unmanned vehicle surveillance.

"We are seeing an uptick in C4ISR [command, control, communications, computers, intelligence, surveillance, and reconnaissance] applications on unmanned vehicles, with video, electro-optical, and sensor fusion all tied together," says Doug Patterson, vice president of business development and marketing at embedded computing specialist Aitech Defense Systems Inc. in Chatsworth, Calif.

When it comes to unmanned vehicles, the driving mantra of onboard sensor processing for unmanned vehicles is SWaP-C, which is short for size, weight, power consumption, and cost. This pressing need is what keeps embedded systems designers up at night. These systems should be small, lightweight, power-efficient, and cost-effective.

Processing unmanned data

It all begins with on-board data processors, which must handle massive amounts of data coming in from still-image and video cameras, radar, signals intelligence (SIGINT), electronic warfare (EW), electro-optical sensors, and other kinds of surveillance and reconnaissance equipment.

"More processing is required on board unmanned vehicles," says Chris Ciufo, chief technology officer at General Micro Systems (GMS) in Rancho Cucamonga, Calif. "PowerPC was the way we did things 10 years ago. Now we have these data-mining applications on UAVS where you are collecting reams of data from these sensors of large-pixel density, from TV and infrared cameras. There's just lots and lots of

data streaming in — terabytes — in real time."

Not only are today's most modern processors powerful, but increasingly they are easier to integrate than previous generations.

"You have the silicon that is much more powerful, and much more user-friendly in terms of programming," says Aitech's Patterson. "The implementation process is almost limitless with the amount of processing that the systems designer has available."

Trends in the miniaturization of processors of many different types has progressed to the stage where they can power shoebox-size, sensor-processing subsystems appropriate for many small- and medium-sized unmanned vehicles. This trend applies to general-purpose central processing units (CPUs), general-purpose graphics-processing units (GPGPUs), vector-processing engines, field-programmable gate arrays (FPGAs), and other components critical to on-board sensor processing.

"Intel, obviously, is a large component of that, but there are other architectures, like ARM, that are growing significantly within military unmanned vehicles," says Mike Southworth, product manager at the Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va. He also cites GPGPUs from Nvidia Corp. in Santa Clara, Calif., as a popular on-board data processor for unmanned systems.

"Intel has released its first system-on-a-chip for the Xeon processor technology that has enabled power consumption like the company's Core i7 processor, but with more cores — 16 for commercial-temperature applications, and 12 cores for industrial temperatures — with 45 watts of thermal dissipation," Southworth says. "The Intel Xeon D brings together a lot of processing cores, much more memory, and on top of that many more PCI Express and 10 Gigabit Ethernet lanes."

While the Intel Xeon D processor offers server-class performance with multiprocessing capability, matching that chip, or other microprocessors, with the Nvidia GPGPU can speed the processing of incoming sensor video. "You can encode or decode video coming from the sensor, or use the GPGPU as a parallel processor," Southworth says.

Improvements in microprocessors suitable for on-board unmanned vehicle sensor processing are expected continue. "We are starting to see a migration to more cores coming up on the Xeons. We already have seen Xeon D-class processors with four, eight, twelve, and up to sixteen cores in a package," says Peter Thompson, director of business development technology at Abaco Systems in Huntsville, Ala.

The Parvus DuraNET 20-11 from Curtiss-Wright Defense Solutions is an ultra-small-form-factor (SFF) rugged 8-port Gigabit Ethernet switch optimized for demanding manned and unmanned vehicle and aircraft platforms.

Sometimes specialized processors are necessary for image and video processing, and sometimes a combination of specialized processors like GPGPUs and a high-performance, general-purpose processor like the Intel Xeon can fit customer needs.

"On the video side, we are seeing interest in GPGPU," says Aitech's Patterson. "They are seeing the need for small, compact repetitive algorithms distributed among hundreds of processors, if not more. You can break down your video into smaller chunks, process those pixels separately, and then combine them later."

In addition to enhanced processing power, unmanned vehicle sensor processing designers also are gaining access to the Intel AVX-512 technology, which adds 512-bit extensions to the 256-bit Advanced Vector Extensions single-instruction multiple data (SIMD) instructions for x86 instruction set architecture (ISA).

"AVX is Intel's name for its vector-processing engine that it puts on its processors," Thompson says. "It's a side-car on the processor, and is designed to do signal and image processing. AVX gives you the capability to process in parallel. Its parallel vector pipeline enables you to manipulate more data per cycle, so you can do more of whatever it is you are doing."

In addition to processing performance, the Intel Xeon offers designers access to a broad range of software support. "If you can use that Xeon ecosystem, you have access to all the software in that ecosystem," says John Bratton, product and solutions marketing manager at Mercury Systems in Andover, Mass.

Networking and I/O

When it comes to transforming raw sensor data into actionable information, pure processing power is only one piece of the puzzle. To run at its optimum speeds, a processor needs the ability to receive data from sensors as quickly as it can process that data.

"You don't want to starve the processor for data," says Mercury's Bratton. "The backplane needs unrestricted fat pipes. We have 10-gigabit or 40-gigabit pipes across 40 channels, and we guarantee the performance."

The S402-LC Mustang rugged and sealed CPU server based on the Intel Xeon E5 processor from General Micro Systems is for aerospace and defense applications that demand SWaP efficiency.

The sensor-processing system must be able to move data within the system, as well as move data to other on-board systems or to satellite links or ground-based networks. For these tasks, on-board data networking and I/O is essential. "Beyond the processor itself is the ability to move data around on the vehicle faster than ever before," says GMS's Ciufo. "Our customers want 10-gigabit fiber Ethernet on board, so we can add an Ethernet switch to route data throughout the platform. Networking is important, because we are talking about something like an on-board data center."

The bandwidth of data links to the ground or to satellite networks is paltry compared to today's on-board networking that fast Ethernet links provide. "You only have a straw as a pipe to the ground or to the satellite," Ciufo says. It's for this reason that today's on-board sensor-processing systems must be able to handle as much data as possible on the unmanned vehicle itself.

Mercury's Ensemble HDS6603 high-density embedded server offers more than one teraFLOP of general processing power in an OpenVPX slot. It has two 1.8-GHz Intel Xeon E5-2600 v3 processors, each with 12 cores to deliver image- and video-processing power for unmanned vehicles.

"That fabric for PCI Express and 10-Gigabit Ethernet can enable a lot of interesting capabilities in technologies like 3U VPX, but now we are going much smaller," says Curtiss-Wright's Southworth.

Ultra-small processing also necessitates the smallest possible I/O, Southworth says. "We can port things like additional I/O integrated right in the box," he adds. "MIL-STD-1553 and ARINC-439 databuses and CANbus for ground vehicles are common in these ultra-small-form-factor boxes. They also have open slots to support some add-on interface cards, which are about the size of business cards, that are pre-fitted into these card slots. With this, the generic computer becomes a customizable computer."

The Parvus DuraCOR 312 from Curtiss-Wright Defense Solutions is an ultra-small form factor embedded mission computer built around the NVIDIA Jetson Tegra X2 (TX2) integrated in a miniature rugged chassis with MIL-grade, high-density connectors.

Southworth says customers of Curtiss-Wright typically know how many extra networking and I/O interfaces they need in each sensor-processing subsystem. "We can integrate that in the boxes we make, and the customers will have all the throughput they need." One trusted partner of Curtiss-Wright's for ruggedized MIL-STD-1553 and ARINC 429 avionics databus interfaces is Data Device Corp. (DDC) in Bohemia, N.Y.

One promising data pipe for unmanned sensor processing is Universal Serial Bus (USB) 3.0, Southworth points out. USB 3.0 can transfer data as quickly as 5 gigabits per second. Its successor, USB 3.1, doubles the speed, and can transfer data as quickly as 10 gigabits per second. These data pipes are becoming common on PC laptop and desktop computers.

"When it comes to ruggedization, USB 3.0 takes some special care," Southworth says. "Your cable length for USB 3.0 will not be at its full potential, and you may need shorter cable runs. You need to make sure your connector interfaces can handle the signal from that connection."

Precision timing

A key component of on-board sensor networking is precision timing, such that processors and nodes on the network can be synchronized with nanosecond accuracy.

"Modern processors and communications devices would come to a halt if they weren't able to synchronize their devices," says Curtiss-Wright's Southworth.

One accepted industry standard for network precision timing is the IEEE 1588 precision time protocol (PTP), which helps synchronize clocks throughout a computer network. It is designed for local systems that require accuracies beyond those attainable using Network Time Protocol (NTP), as well as for applications that neither can bear the weight or cost of a separate GPS receiver at each node, nor for which GPS signals are inaccessible.

IEEE 1588 "is an increasing requirement in unmanned vehicle Ethernet networks," Southworth says. It's not just for synchronizing networking nodes, but also for unmanned vehicle navigation in areas where signals from Global Positioning System (GPS) satellites are jammed or otherwise denied.

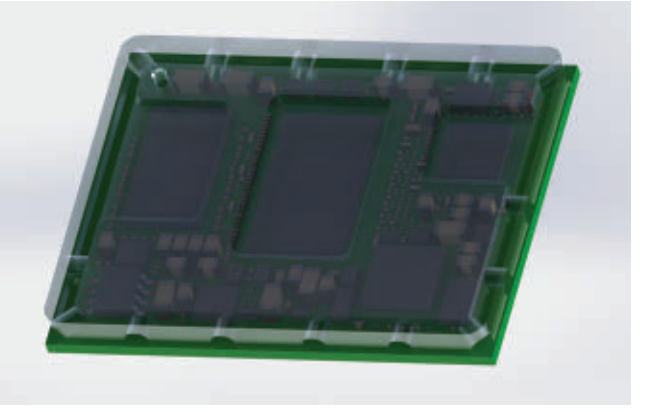
The military has one program of record called Mounted Assured Position, Navigation, and Timing (MAPS), Southworth says. "The goal is to leverage redundancy in position, navigation, and timing [PNT] by distributing PNT timing," he says. "You

have a chip-scale atomic clock to assure precision timing, rather than from a GPS device. It's connected to an Ethernet switch to distribute all this PNT data. The Army and the other services view this as one way to deal with GPS degradation and GPS denial. Assured PNT is validating the truth of where you are and where you're going."

Data storage and memory

There are additional components of unmanned sensor processing. One overriding technology is fast data storage.

"The mission of a UAV is to collect information the battlefield. Storing the information is hugely important," says GMS's Ciufo. "When we went from rotating media to solid-state drives, things got a lot better."



The S2002-MD Golden-Eyes II from General Micro Systems offers two isolated rugged servers based on the Intel Xeon-D and removable data storage drives for unmanned vehicles and other small-form-factor applications.

Solid-state drives fixed a lot of the problems of rotating data storage — especially when it comes to ruggedization, reliability, and size. It does have a downside: "It's more expensive for the density you get," Ciufo says.

Yet data storage continues to improve, and is enabling data storage to be a big contributor of unmanned sensor processing capabilities. One of the most significant advances is Non-Volatile Memory Express (NVMe), which enables systems designers to access non-volatile storage media like the Flash memory in solid-state memory devices via the PCI Express bus. NVMe enables host hardware and software to use parallelism in modern solid-state drives.

NVMe "eliminates the need for a hard disk controller and avoids the latency of accessing the drive directly," Ciufo explains. "The processor can talk directly to the drive, and boosts the performance of streaming data to the drive."

Mercury Systems uses special hardening to ruggedize high-performance embedded computing sufficiently for use in unmanned vehicle sensor-processing subsystems.

Other advantages of NVMe include its ability to be ruggedized for applications like unmanned vehicles, as well as its ability to carry out fast data encryption and decryption. "You can buy NVMe drives that do multi-encryption on the fly, and we are doing that as well," Ciufo says.

Mercury Systems engineers are addressing SWaP in on-board data storage with a 3D stacking technique for flash memory in solid-state memory devices. On-board sensor processing "relies on vast amounts of memory, and memory takes up space," says Mercury's Bratton.

"On the Xeon boards, we are doing dense memory stacks and reducing the footprint the memory takes on the board by about 90 percent," Bratton says. "We connect the memory to the board with BGA packaging. It is very dense and rugged memory attached to the board."

Another benefit to Mercury's rugged on-board, solid-state memory in its high-performance Xeon embedded computing boards is the technology's intense level of ruggedization. "We have experience in smart munitions," Bratton explains. "We can make these stacked chips gun-hardened, and we can leverage this technology to make these payloads quite small."

Power and thermal management

Dense, powerful computing sized small enough for on-board unmanned sensor-processing payloads can have two substantial drawbacks: substantial power requirements, and difficulty to cool. Hence, power and thermal management on unmanned sensor-processing payloads need to be considered up-front in any system design.

"These systems need massive processing, and are very dense down to the memory, so cooling is critical," says Mercury's Bratton. "Mercury's air flow-by and liquid flow-by technologies helps our boards run cooler."

Air flow-by, reflected in the VITA 48.7 open-systems standard, involves cooling and sealing technologies for VPX and VPX REDI embedded computing systems. It uses convection heat transfer to cool plug-in modules while shielding circuit boards and backplanes from the cooling air with plate with apertures for backplane connectors over the backplane.

Liquid flow-by, meanwhile, enables open-systems modules to operate unrestricted and reliably, regardless of the presence of a cooling air supply. It integrates liquid-cooling capability to remove about 50 percent more heat than pure air-cooled approaches.

The GVC2000 from Abaco Systems is a mission or graphics computer intended for symbol generation, mission computing, demanding graphics generation applications, and GPU-accelerated data processing.

Liquid flow-by thermal management can use an unmanned vehicle's own fuel as a cooling liquid. Fuel enters each module through non-drip, quick disconnects to complement or take over the native air cooling capability of each module. Non-drip technology makes each module and supporting chassis a self-sealing entity, which is critical for liquid cooled subsystems, especially when the coolant is fuel. In the absence of cooling air, the coolant takes over completely.

In addition to cooling, unmanned vehicle sensor payloads are starting to rely in a variety of digital power control architectures to help squeeze out every bit of capability for a given source of power — especially when the vehicle makes broad use of battery power.

Smart power management can help balance power loads over the whole vehicle — including separate networked sensor payloads — and even borrow power from systems with light power demands to help systems under intense power loads.

Security, safety, and trusted computing

Those specifying unmanned vehicles and on-board sensor payloads increasingly are demanding special provisions that guarantee safe operations of these unmanned systems alongside manned craft, guarantee performance under demanding circumstances, ensure that software and hardware do not interfere with one another to produce errors and faults, and that guard against the intentional insertion of malware to disrupt or bring down computer operations.

"Security isn't optional anymore; it needs to baked into all these solutions," says Mercury's Bratton. "With more of the sensor chain on board, security has to be part of sensor, processing, data storage, and back again." The sophistication of unmanned sensors and sensor processing also is bringing artificial intelligence and decision-support aboard unmanned vehicles. "The sensors themselves are starting to make decisions, and safety-certifiable is starting to be critical," he says.

Trusted computing doesn't only deal with shielding against viruses and other malware. It also involves allocating and balancing computer resources so life- and mission-critical functions take priority over other non-critical tasks. It also uses built-in routines to prevent the inadvertent corruption of computer data or instructions from unanticipated system transactions, and the accidental dissemination of data that should remain private to the system.

"Everything these days has sensors, and produces a deluge of information," says Mercury's Bratton. "This uses a cloud-like model, where information feeds to a server that can manage the information, take information out, and parcel it out to users that need it."

One way of keeping everything straight is the use of software hypervisors. "Security architectures use hypervisors that separate command-and-control, data acquisition, and other functions," says Erik Kramer, product manager at Mercury Systems. "You can separate functionality by hypervisor to privacy and security concerns. If one domain fails, using hypervisors guarantees that it doesn't bring the whole system down."

The same principle applies to separate parts of a sensor-processing system that might be overworked. "If one function in a system is challenged at the moment, you can use hypervisor technology for guaranteed levels of performance reserved for other functions that are critical," Kramer says.

Reinventing electronic warfare with investment in new technologies

The Pentagon's recently completed electronic warfare strategy calls for increased investment in advanced electronic warfare (EW) technology designed for defense, as well as a proactive use of emerging electromagnetic spectrum systems to attack enemies. The vision of the electronic warfare strategy is to be agile, adaptive, and integrate EW to offensively achieve electromagnetic spectrum superiority across the range of military operations. Goals include organizing the EW enterprise to ensure electromagnetic spectrum superiority, training and equipping EW forces, and strengthening partnerships with allies, industry, and academia. This U.S. Department of Defense (DOD) EW strategy took on new urgency following Russia's successful use of advanced EW technologies in Ukraine and the pace of global technological progress in the area of EW systems.

BAE, General Dynamics, Airbus to develop tactical hotspot for British Army

BAE Systems, Airbus, and General Dynamics (GD) have partnered to develop the Strike Tactical Hotspot concept demonstrator, a new network technology for the British Army. Tactical Hotspot is a compact mobile digital communications set that can be deployed securely in

Raytheon to build TOW radio-controlled anti-tank missiles

BY **John Keller**

REDSTONE ARSENAL, Ala. — The Raytheon Co. will build radio-controlled anti-tank missiles for the U.S. Army and the military forces of Saudi Arabia and Lebanon under terms of a $31.5 million order.

Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., are asking Raytheon Missile Systems in Tucson, Ariz., to build the Tube-Launched, Optically-Tracked, Wireless-Guided munition, better-known as the TOW missile.

The Army Contracting Command is placing the order on behalf of the Army Aviation and Missile Command at Redstone Arsenal. Versions of the TOW missile have been in the U.S. inventory since 1970.

The multimission TOW 2A, TOW 2B, TOW 2B aero, and TOW bunker-buster missile is one of the primary precision anti-armor, anti-fortification, and anti-amphibious landing weapons used throughout the world today.

TOW missiles can be fired from all TOW launchers, including the Improved Target Acquisition Systems (ITAS), Stryker anti-tank guided missile vehicle (modified ITAS), and Bradley Fighting Vehicles (Improved Bradley Acquisition Subsystem). TOW launchers can be mounted to a wide variety of vehicles, including the Humvee, and can be placed in improvised ground fortifications for front-line infantry use. Versions of the TOW missile also can be fired from Light

Operators control the TOW missile in flight using radio links between its launcher and the missile.

Armored Vehicle–Anti-tank and U.S. Marine Corps AH-1W Cobra attack helicopter.

To fire the TOW missile, the operator uses an optical missile sight attached to the launcher. The sight is data linked to the missile. Wireless TOW missiles include an RF transmitter added to the missile case and an RF receiver located inside the missile. When the missile fires, the RF transmitter in the launcher relays information to the missile while in flight. The operator keeps the sight fixed on the target — even if the target is moving — to guide the missile to its target. Original versions of the TOW, which were called the tube-launched, optically-tracked, wire-guided missile, trailed a thin wire that relayed information to the missile from the sight.

On this order, Raytheon will do the work in Tucson, Ariz., and Farmington, N.M., and should be finished by December 2018.

FOR MORE INFORMATION visit **Raytheon Missile Systems** online at *www.raytheon.com*.

Orbital ATK to upgrade 230 AARGM anti-radar missiles

BY **John Keller**

PATUXENT RIVER NAS, Md. — U.S. Navy air warfare experts are upgrading 230 air-to-ground, radar-killing AGM-88B High Speed Anti-Radiation Missile (HARM) systems to the AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) to equip the service's carrier-based fighter-bombers and electronic warfare jets.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $156.8 million contract to the Orbital ATK Defense Electronic Systems segment in Northridge, Calif., to convert AGM-88B HARM munitions into 230 AGM-88E AARGM all-up-rounds. The contract, which involves lot 6 of AARGM production, includes six captive air training missiles, supplies, services, spare parts, and fleet deployment.

The newest version of the AGM-88 missile is compatible with U.S. and allied strike aircraft, including the F/A-18 fighter bomber, EA-18G electronic warfare jet, Tornado, F-16, and F-35. The missile program is a joint venture by the U.S. Department of Defense (DOD) and the Italian Ministry of Defense. The AGM-88E provides the U.S. Navy, U.S. Marine Corps, and Italian air force with the ability to engage and destroy enemy air defenses and time-critical mobile targets.

The AARGM boasts an advanced, digital, anti-radiation homing sensor, millimeter-wave radar terminal seeker, global positioning system/inertial navigation system guidance, net-centric connectivity, and weapon-on-impact-assessment transmit.

The AGM-88E AARGM missile is designed to suppress enemy air defenses by homing-in on and killing hostile radar installations.

The new missile offers improved capabilities over the HARM systems it replaces, including advanced signal processing, improved frequency coverage, detection range, and field of view; time-critical, standoff strike; missile-impact zone control to prevent collateral damage; counter-emitter shutdown through active millimeter-wave radar terminal guidance; and bomb damage assessment.

The AARGM features new software and enhanced capabilities to counter radar shutdown and passive radar using an additional active millimeter-wave seeker. Previous versions of the missile could be spoofed by turning off radar before the weapon could lock on to their signals. The missile has been in full production since 2012.

The missile will be integrated onto the F/A-18C/D, F/A-18E/F, EA-18G, and Tornado ECR aircraft and later on the F-35. On this contract, ATK will do the work in Northridge, Calif., and Ridgecrest, Calif., and should be finished by March 2019.

FOR MORE INFORMATION visit **Orbital ATK Defense Electronic Systems** online at *www.orbitalatk.com/defense-systems/defense-electronic-systems*.

an armored vehicle to enable front-line troops to communicate securely with their command headquarters. When fitted to an adapted, Panther armored combat vehicle with self-erecting radio masts, the Hotspot can provide secure connectivity over several miles. It can maneuver alongside the British Army's medium strike brigade for continuous secure communications on the move. Under a contract worth $1.62 million, BAE will supply two experimental Strike Tactical Hotspots to the British Army.

Navy electronic warfare helicopters to help defend ships from missile attack

The U.S. Navy and Lockheed Martin Corp. have wrapped up a preliminary design review of a helicopter-based electronic warfare (EW) pod designed to help ship crews detect and respond to anti-ship missile threats. Lockheed Martin officials say their company's Advanced Off-Board Electronic Warfare (AOEW) Active Mission Payload AN/ALQ-248 system aboard MH-60 helicopters provides the aircraft with surveillance and EW capabilities against anti-ship threats with radio-frequency countermeasures. AOEW can function independently or work with the ship's SEWIP Block 2 AN/SLQ-32(V)6 electronic surveillance sensor to detect and assess the trajectory of incoming missile threats.

Navy funds Bodkin Design to develop light source for nighttime reconnaissance

Bodkin Design & Engineering LLC in Newton, Mass., won a $1.5 million U.S. Navy research contract to develop a power-efficient illuminator for nighttime operations of the Coastal Battlefield Reconnaissance and Analysis (COBRA) system. The COBRA multispectral illuminator will provide broadband light with sufficient electro-optical illumination for the COBRA camera to operate under all light conditions. The COBRA airborne payload is carried on the MQ-8 Fire Scout unmanned aircraft.

Insitu to provide six ScanEagle unmanned aircraft for Philippines

Unmanned aerial vehicle (UAV) designers at Insitu Inc., a subsidiary of Boeing, in Bingen, Wash., will build six ScanEagle small UAVs for the government of the Philippines under terms of a $7.4 U.S. Navy order. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking Insitu to provide six ScanEagle UAVs, support equipment, training, site activation, technical services, and data for the Philippines. The ScanEagle UAV is 5.1 feet long with a 5.6-foot wingspan weighing as much as 48.5 pounds. Able to carry a 7.5-pound sensor payload, the UAV can fly for more than 24 hours

Orbital ATK to develop hypersonic propulsion for aircraft, UAVs, and missiles

BY **John Keller**

ARLINGTON, Va. — Aviation propulsion experts at Orbital ATK Inc. in Elkton, Md., are helping U.S. government researchers develop a full-scale reusable propulsion system for future hypersonic aircraft and missiles that can fly at least five times the speed of sound.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have announced a $21.4 million contract to ATK for the Advanced Full Range Engine (AFRE) program. This project seeks to develop and ground-demonstrate a full-scale, reusable turbine-based combined-cycle (TBCC) propulsion system for future hypersonic aircraft. TBCC combines a turbine engine for low-speed operations with a ramjet/scramjet for high-speed operations via a common inlet and nozzle.

Reliable hypersonic propulsion technology will be necessary for future generations of high-speed manned and unmanned military aircraft, as well as for next-generation anti-ship missiles and other smart munitions, DARPA officials say. Hypersonic propulsion may enable military aircraft and missiles to fly from long ranges with short response times compared to current military systems.

Orbital ATK is developing hypersonic propulsion for future generations of U.S. manned and unmanned aircraft, as well as missiles.

Developing hypersonic aircraft and missile propulsion confronts engineers with two difficult challenges. First, the top speed of traditional jet-turbine engines maxes out at roughly Mach 2.5. Second, hypersonic engines such as scramjets cannot provide effective thrust at speeds much below Mach 3.5.

The AFRE program seeks to combine the best commercially available technologies in jet turbine engines and ramjet/scramjet technologies.

"We're envisioning an inventive hybrid system that would combine and improve upon the best off-the-shelf turbine and ramjet/scramjet technologies," says Christopher Clay, the DARPA AFRE program manager. "With recent advances in manufacturing methods, modeling, and other disciplines, we believe this potentially ground-breaking achievement may finally be within reach."

The first phase of the AFRE program calls for Orbital ATK to conduct system design, subscale and large-scale component development, and ground demonstration.

FOR MORE INFORMATION visit **Orbital ATK** online at *www.orbitalatk.com*.

Raytheon to upgrade venerable Tomahawk missile for next-gen, anti-ship role

BY **John Keller**

PATUXENT RIVER NAS, Md. — Smart munitions experts at the Raytheon Co. are upgrading the venerable Tomahawk land-attack missile (TLAM) for the anti-ship role with a new sensor system to enable the weapon to attack moving enemy ships at sea.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $119 million order to the Raytheon Missile Systems segment in Tucson, Ariz., to integrate seeker suite technology and processing capabilities into the Tactical Tomahawk Block IV missile in support of the Maritime Strike Tomahawk Program.

The order provides for analysis, trade studies, architecture, modeling, simulation development, evaluation, and prototyping activities for an anti-ship missile version of the Tomahawk, which will be called the Maritime Strike Tomahawk variant.

Raytheon and Navy experts are determining the most appropriate type of sensor for the Maritime Strike Tomahawk. It could be a multi-mode seeker with a mix of passive and active sensors.

The upgrade of Tomahawk land-attack missiles to maritime strike variants also will involve warhead enhancements, and technology to enable the new missiles to operate in areas where GPS satellite navigation signals are jammed or otherwise inoperative.

The first of the Maritime Attack Tomahawk missiles should be ready by the early 2020s. A supersonic version of the Tomahawk with a ramjet to increase its speed to Mach 3 is under consideration. On this order, Raytheon will do the work in Tucson, Ariz.; Dallas; Boulder, Colo.; and at other locations, and should be finished by August 2019. ←

Raytheon is working with the Navy to upgrade the venerable Tomahawk cruise missile to attack moving targets and perhaps fill a next-generation, anti-ship missile need.

FOR MORE INFORMATION visit **Raytheon** at *www.raytheon.com*.

at altitudes as high as 19.500 feet, and at speeds to 80 knots. ScanEagle can carry a sensor payload consisting of visible-light camera, medium-wave infrared imager, or both integrated in one turret. The UAV also has an analog digitally encrypted video data link, as well as encrypted or unencrypted command-and-control data link. The UAV can be launched autonomously and uses a no-nets recovery system that recovers with its wing tip on a rope that hangs from a boom.

Athena laser weapon shoots down five drones

Lockheed Martin has released footage from tests with its laser weapon system, revealing how the Advanced Test High Energy Asset (Athena) laser weapon can deliver an invisible killing blow to take down an enemy drone. In the tests conducted at New Mexico's White Sands Missile Range, the prototype laser weapon shot down five unmanned Outlaw aircraft. The video shows the moment flames burst from the tails of the flying drones one by one before they plummet toward the ground, as the silent attack causes loss of control and structural failure. Lockheed Martin and the U.S. Army's Space and Missile Defense Command conducted the tests using the 30-kilowatt-class Athena system. See the video online at *https://youtu.be/hNsUtZmWgdg*. ←

Optics and laser gun sight for machine guns introduced by B.E. Meyers

B.E. Meyers & Co. Inc. in Redmond, Wash., is introducing the BOARS-M2 — short for B.E. Meyers Optics & Accessories Rail System — optics and laser accessory rail gun sight system for M2, M2A1, and M3 .50 caliber heavy machine guns. The BOARS-M2 is a low-profile mount that offers a quick-disconnect with return-to-zero reattach. Key features for the BOARS-M2 include: a quick detach optics and laser rail, snag-free design, non-marring installation, low-height over bore, and oversized pass-through aperture for use with iron sights.

The BOARS-M2 is composed of two parts: the lower base and a quick-detach optics and accessory rail. This allows for quick and effective changes between day and night optics without any loss of zero. The mount also simplifies cleaning and maintenance. While legacy systems require users to remove the optic and mount — resulting in a complete loss of zero — the BOARS-M2 requires only the quick-detach of the optics and accessory rail, which preserves optic zero after reinstalling all components.

DARPA smart sensor powered by the infrared it is designed to detect

Researchers at Northeastern University have developed a next-generation smart sensor for the Defense Advanced Research Projects Agency (DARPA) that is capable of identifying infrared (IR) wavelengths — without having to have its own always-present

Raytheon to upgrade Marine Corps CH-53E helicopter cockpit displays

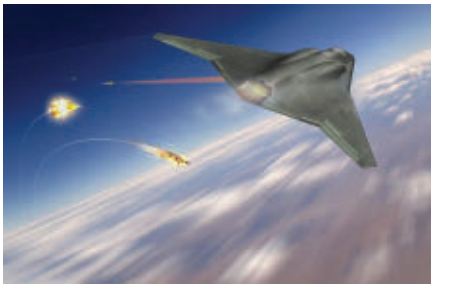
BY **John Keller**

PATUXENT RIVER NAS, Md. — Avionics designers at Raytheon Co. will produce 63 smart multifunction color display (SMFCD) B-kits to upgrade the avionics aboard U.S. Marine Corps CH-53E heavy-lift helicopters under a $15.1 million U.S. Navy order.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking Raytheon Intelligence, Information, and Services in Indianapolis to produce these cockpit display upgrade kits. Marine Corps leaders are attempting to reduce the number of lost aircraft and personnel due to poor situational awareness.

CH-53E air crews need to be able to process, filter, sort, and display information from various sources to enhance situational awareness. The smart displays consolidate all the helicopter's survivability information, blue force tracking, and some time-sensitive threat information onto one display. Marine Corps CH-53 crews have all this information today, but must view it in different places in the cockpit.

The SMFCD has its own integrated processor, which enables pilots to display and manipulate current data streams cleanly using one color display screen for each pilot. This SMFCD enables the CH-53E air crew to view forward-looking infrared (FLIR) picture information with intuitive hover display, aircraft flight instrument data, integrated moving map display, and real-time threat display. This approach can eliminate



The smart multifunction color display (SMFCD) consolidates all the CH-53E helicopter's survivability information, blue force tracking, and some time-sensitive threat information onto one display.

the need for a separate pen tablet computer to display aircraft position. The SMFCD can accommodate future aircraft modifications, such as Situational Awareness Data Link (SADL), LARS V12, and Intelligence Broadcast Receiver.

The CH-53E Super Stallion by Sikorsky Aircraft Corp. in Stratford, Conn., is a three-engine heavy-lift helicopter used to transport Marine Corps infantrymen and equipment from landing ships offshore to invasion beaches, and for general-purpose, heavy-lift helicopter operations.

Raytheon engineers are modifying the company's existing SMFCD to meet the updated requirements, integrate a prototype SMFCD system into a CH-53E helicopter, perform qualification and aircraft flight testing, as well as build and install prototype displays. On this order, Raytheon will do the work in Indianapolis, and should be finished by August 2020 ←

FOR MORE INFORMATION visit **Raytheon** online at *www.raytheon.com*.

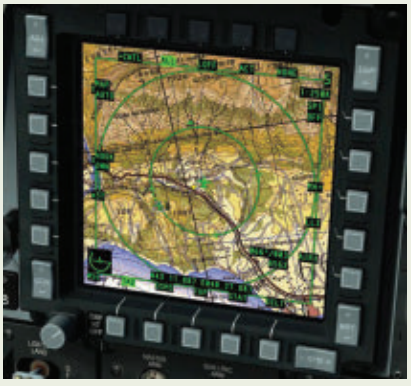
Lockheed Aculight eyes high-power laser to defend tactical aircraft

BY **John Keller**

KIRTLAND AIR FORCE BASE, N.M. — Laser weapons experts at Lockheed Martin Corp. are helping the U.S. Air Force develop a compact, ruggedized, high-power laser to defend tactical aircraft flying at or above the speed of sound from enemy aircraft and missiles.

Officials of the Laser Division of the Air Force Research Laboratory's Directed Energy Directorate at Kirtland Air Force Base, N.M., announced a $26.3 million contract to Lockheed Martin Aculight in Bothell, Wash., for the Laser Advancements for Next-generation Compact Environments (LANCE) project. LANCE seeks to explore ways of reducing risk for laser weapons on aircraft. Lockheed Martin Aculight experts will help advance the state of the art in laser technologies, demonstrate performance, and assess the operational utility of a laser weapon small enough to fit on tactical aircraft like jet fighters.

The LANCE project is part of the Air Force's Self-protect High Energy Laser Demonstrator (SHiELD) program to develop and assess a high-energy laser for use against enemy aircraft, missiles, and other airborne threats. On the SHiELD program, Northrop Grumman Corp. Aerospace Systems in Redondo Beach, Calif., is developing beam-control technology to protect current and future fighter aircraft with directed-energy systems. Northrop Grumman is using a laser housed in a pod attached to a fighter-sized aircraft.



Lockheed Martin Aculight is developing a prototype laser for potential use aboard tactical aircraft to defend against enemy planes, missiles, and other airborne threats.

Air Force researchers are asking Aculight to demonstrate a ruggedized, high-power laser subsystem for flight testing on the Northrop Grumman aircraft-attached SHiELD pod. This laser must minimize beam quality degradation under the stressing flight conditions of high-performance tactical aircraft.

Aculight experts will quantify the performance of this airborne defensive laser system for laser output power, electrical-to-optical efficiency, power stability, beam jitter, and power in the bucket. The laser must be able to withstand the G loads and vibration of tactical aircraft maneuvers, and must be ready for flight demonstrations by 2021.

On this contract, Lockheed Martin Aculight will do the work in Bothell, Wash., and should be finished by September 2022. ←

FOR MORE INFORMATION visit **Lockheed Martin** online at *www.lockheedmartin.com*.

power source. Instead, the smart sensor is powered by the same infrared wavelengths for which it's designed to look. The sensor was developed as part of DARPA's Near Zero Power RF and Sensor Operation (N-ZERO) program and could be used for a wide range of things, including detecting approaching human bodies or fuel-burning cars, identifying wildfires before they become uncontrollable, or pairing with laser sources for new types of remote control and communication applications. The sensors are based on tiny mechanical switches that are triggered by specific wavelength of lights. When this happens, they utilize the energy contained in these wavelengths to mechanically close a pair of electrical contacts, creating a low-resistance electrical connection between a battery and a load.

BAE Systems developing technology to protect pilots from laser attacks

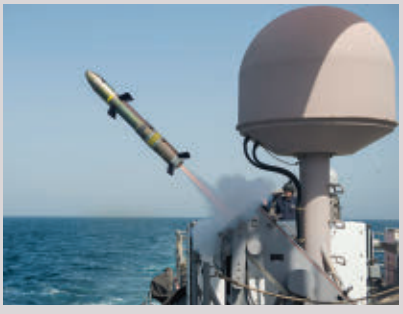
BAE Systems engineers have developed a low-cost, lightweight, flexible system that can block dangerous laser light, protecting pilots and flight crew from hostile attacks. The laser-protection technique for aircraft is selective in the way it prevents laser transmission, meaning a high level of natural light still can pass through the canopy with minimal color distortion. Pilots are protected from dangerous laser incidents with no deterioration in vision. Laser attacks targeting pilots and air crews are a major concern, and can distract pilots, obscure instruments, and cause short-lived 'flash' blindness. ←

PRODUCT applications

MUNITIONS

Raytheon to build lightweight missile to arm UAVs and aircraft

U.S. Air Force airborne weapons experts are asking the Raytheon Co. to build a lightweight missile and glide bomb that features low collateral damage and is suitable for launch from a variety of unmanned aerial vehicles (UAVs), military manned aircraft, and surface warships.



Officials of the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., announced a $104.9 million contract to the Raytheon Missile Systems segment in Tucson, Ariz., to build, test, and support the AGM-176 Griffin missile.

Griffin is a lightweight, precision-guided munition that can launch from the ground, from the air as a rocket-powered missile, or drop from the air as a guided bomb. It carries a relatively small 13-pound warhead for low-collateral damage, as well as for use in irregular warfare.

The munition comes in two versions. Griffin A is an unpowered precision munition that can be dropped by aircraft from a rear cargo door or a door-mounted launcher. Griffin Block II B is a short-range missile that can be fired from UAVs as well as manned helicopters, attack aircraft, U.S. Air Force AC-130W gunships, and U.S. Marine Corps KC-130J tankers.

Griffin is less than half the weight of a Hellfire round and offers GPS-aided inertial guidance and a semi-active laser seeker. It has a 10-mile range when air-launched, and a 3-mile range when launched from the surface. Three Griffins can be carried in place of one Hellfire. The Griffin missile and launch assembly is also lighter than the Hellfire, allowing more to be mounted on the Predator.

The U.S. Navy has tested the Griffin as a laser-guided shipboard missile to attack fast-moving small boats. Raytheon also is developing the Griffin C with dual-mode guidance; and the Griffin C-ER, which will be an extended-range missile.

On this contract, Raytheon will do the work in Tucson, Ariz., and should be finished by December 2018.

FOR MORE INFORMATION visit **Raytheon Missile Systems** online at *www.raytheon.com*.

THERMAL MANAGEMENT

Global Technical providing thermal management for shipboard embedded computing

U.S. Navy shipboard electronics experts needed ways to tap shipwide air conditioning to provide thermal management for onboard rackmount embedded computing racks and cabinets. They found their solution from Global Technical Systems in Virginia Beach, Va.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., announced an $11.9 million order to Global Technical Systems to develop and deploy an efficient cooling system for Navy shipboard computers.

This order involves the third phase of the Navy's Improved, Flexible Infrastructure Compatible, Open-Loop Air-Cooled Computer Rack and Cabinet project, which seeks to eliminate standard computer cooling fans by bringing in cooled air from the ship's heating, ventilation, and air conditioning (HVAC) systems and exhausting hot air from the top of the computer racks near air returns.

Global Technical Systems experts will help the Navy install and evaluate a new air conditioning and electronics thermal-management system appropriate for naval vessels. If tests are promising, this

computer thermal management system first may be installed aboard the America-class amphibious assault ship USS Bougainville (LHA-8), which will be built at the Huntington Ingalls Industries shipyard in Pascagoula, Miss., and delivered to the Navy in 2024. Experts are exploring outfitting spaces aboard the Bougainville with electronics cooling systems mounted to the deck and bulkheads, and in the overhead.

Today's standard computer racks and cabinets use side- and back-mounted fans and require a duct connected to the ship's HVAC system to remove heat from shipboard computer rooms. Global Technical Systems has developed more efficient cooling for individual computer racks and cabinets using below-deck HVAC system supply air.

In the project's first and second phases, Global Technical Systems developed a prototype air-cooled computer rack system, and established its feasibility with component testing and analytical modeling. Now the company will refine this prototype for realistic shipboard testing.

Not only will this system cool individual computer racks with shipboard air conditioning, but it also will control the supply of cool air to compensate for varying cooling demands. The system prototype will maintain existing computer rack size, shape, weight, and shock-mount effectiveness, and demonstrate reliability and performance that is better than current shipboard computer thermal-management approaches.

This approach could reduce the need for new computer rack foundations and HVAC ducting, and help the Navy reconfigure on-board electronics and computer spaces as system updates and changes occur. It could help eliminate large amounts of HVAC ducting, reduce the need to rebalance the HVAC system, and reduce costs, Navy officials say.

FOR MORE INFORMATION visit **Global Technical Systems** at *http://gts.us.com*.

TEST AND MEASUREMENT

Behlman to provide avionics test equipment for Navy weapons launchers

U.S. Navy aircraft weapons experts needed avionics test and measurement equipment for missile and weapons launchers aboard the F/A-18 jet fighter bomber and other combat aircraft. They found their solution from Behlman Electronics Inc. in Hauppauge, N.Y.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., announced a $21.7 million contract to Behlman to build as many as 180 Common Aircraft Armament Test Sets (CAATS) and 100 Pure Air Generator System Adapter Sets (PAGS PAS). The CAATS/PAS helps test and troubleshoot U.S. Navy, Marine Corps, and international military bomb racks, missile launchers, pylons and emerging weapons carriage devices across most aircraft weapons systems at the intermediate maintenance level.

Behlman will build weapons-launcher test and measurement equipment for the Navy and Marine Corps, as well as the militaries of Spain, Italy, Finland, and Kuwait.

The CAATS system tests rack and launcher weapons interfaces off the aircraft prior to the loading of ordnance to ensure proper system functionality and safety. The CAATS/PAS replaces the legacy A/E37T-35A common rack and launcher test set (CRALTS) which has reliability and obsolescence issues.

The PAS interfaces with the CAATS to test the LAU-7 and LAU-127 high-pressure, pure air generator (HiPPAG) weapons launchers. It provides pressure test capability to evaluate emerging pneumatic pressure release launchers, such as the Joint Miniature Munitions Bomb Rack Unit.

The LAU-7 air-to-air missile launcher carries and deploys the

AIM-9 heat-seeking missile and instrumentation pods on Navy and Marine Corps F/A-18 fighter-bombers. The LAU-127 missile rail launcher, meanwhile, enables the F/A-18 to carry and launch the radar-guided AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM) and AIM-9X advanced heat-seeking missile.

The LAU-127 provides the electrical and mechanical interface between the AMRAAM and AIM-9X missiles and the F/A-18 aircraft, as well as two-way data transfer between the missile and the aircraft's cockpit controls and displays.

On this contract, Behlman will do the work in Hauppauge, N.Y., and Indianapolis, and should be finished by September 2020.

FOR MORE INFORMATION visit **Behlman Electronics** at *www.behlman.com*.

new PRODUCTS

To submit new products for consideration, contact John Keller at jkeller@pennwell.com.

MISSION COMPUTERS

Rugged embedded computing system for developing avionics mission computers introduced by Abaco

Abaco Systems in Huntsville, Ala., is introducing the Lightning embedded computing system for developing rugged embedded

mission computers for avionics and other mission-critical systems. Lightning-based systems are designed with I/O customization to help systems integrators reduce development cost and time. The first two Lightning-enabled systems — the MCS1000 and GVC2000 — were announced in September. The rugged, small-form-factor MCS1000 mission or display computer is for I/O-rich applications with several target platforms or interfaces. The system has the Intel Xeon E3 processor combined with a CoreAVI (or AMD) E8860 GPU, as much as 16 gigabytes of DDR4 SDRAM and an XMC site. This system is for avionics mission computer and display applications such as sensor fusion and sensor processing, or as a data processing and display computer. The rugged, small-form-factor GVC2000 display computer is for applications in degraded visual environments, complex scene rendering, or driving several independent displays all requiring extensive GPU processing capabilities.

FOR MORE INFORMATION visit **Abaco Systems** online at *www.abaco.com*.

DATA STORAGE

Memory and data exchange system for military data storage introduced by Kaman

The Memory Division of Kaman Precision Products in Middletown, Conn., is introducing the Advanced Memory and Data Exchange Universal System (AMADEUS) for use in harsh-environment military, aerospace, and industrial data storage applications. The AMADEUS includes the model 9740 Multi-Port data transfer unit which includes four removable memory cards

(RMC) and a mini-Ground Station Adapter (GSA). The model 9740 provides simultaneous data interface over 10 Gigabit Ethernet, Mil-Std 1553, and RS-232/422, as well as options to record multiple SMPTE 292 and NTSC (RS-170) video/audio channels. Each Kaman RMC has a capacity of 2 terabytes with AES 256 encrypted data-at-rest. The pocket-sized GSA facilitates expeditionary operations and enables the operator to connect with virtually any computer via USB 3.0 exchange pre- and post-mission data rapidly.

FOR MORE INFORMATION visit **Kaman Memory** online at *www.kamanmemory.com*.

BOARD PRODUCTS

Intel Xeon VME single-board computer introduced by Mercury

Mercury Systems Inc. in Andover, Mass., is introducing the Ensemble

4000 series SBC4510 Intel Xeon E3 v6-based VME single-board computer for existing VME-based, sensor-processing embedded computing applications that supply 50 watts or less. The computer board will enable technology insertion of modern high-performance and system-security engineering solutions with system security engineering capabilities — a key enabler for foreign military sales and direct commercial sales. The single-slot computer board is compatible with legacy VME64 systems, and supports Linux and VxWorks operating systems It offers a secure

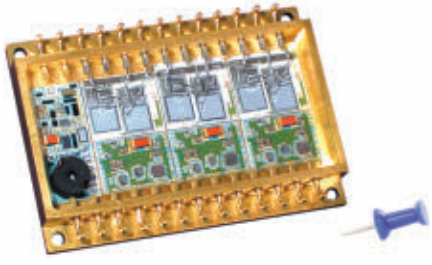
hypervisor to enable legacy applications to run in their own containers independently of the underlying system software and hardware. Several applications can run simultaneously in a virtualized environment to take advantage of the increase in performance of the Intel Xeon processor.

FOR MORE INFORMATION visit **Mercury Systems** online at *www.mrcy.com/SBC4510*.

POWER ELECTRONICS

High-power electric motor drive for military applications introduced by DDC

Data Device Corp. (DDC) in Bohemia, N.Y., is introducing the PWR-82335 high-power, three-phase bridge electric motor drive for harsh-environment, space-constrained defense and aerospace applications. The PWR-82335 is



designed to deliver current precisely to windings of three-phase brush and brushless DC motors, with a high-efficiency MOSFET drive stage. The rugged, compact, three-phase motor drive hybrid uses a high-efficiency MOSFET drive stage with a 200-volt DC rating to deliver a high-speed switching frequency as high as 50 kHz, and a high-current capability of as much as 30 amps to the motor. The power electronics device operates in temperatures from -55 to 125 degrees Celsius, and has military processing options.

FOR MORE INFORMATION visit **DDC** online at *www.ddc-web.com*.

RAD-HARD SPACE

Radiation-tolerant DC-DC converters introduced by Crane Aerospace

Crane Aerospace & Electronics

in Redmond, Wash., is introducing the SMHF42 space-grade DC-DC converters for space systems integrators who need radiation-tolerant power electronics that support 42- and 50-volt power buses. Crane Interpoint DC-DC converters are used on satellites and space systems, including Mars Rovers, Cygnus, Aquarius, GLONASS, ISS, Dawn, and many more. The SMHF42 is a family of isolated 15-watt power electronics products with a range of single and dual outputs, operating over an input voltage range of 35 to 55 volts with 80-volt transient protection. They are available in Class H and Class K versions (per MIL-PRF 38534) with radiation tolerance of L and R. The power supplies are reliable under harsh conditions, have small hermetically sealed packages and operate over the military temperature range of -55 to 125 degrees Celsius.

FOR MORE INFORMATION visit **Crane Aerospace & Electronics** online at *www.interpoint.com*.

INTERCONNECTS

Connectors to help eliminate backplanes introduced by TE Connectivity

TE Connectivity in Harrisburg, Pa., is introducing the cabled STRADA Whisper connectors to help eliminate the need for printed circuit board (PCB) backplanes in high-performance computing (HPC) and core routing applications. The cabled STRADA Whisper connectors can support 25- to 56-gigabit-per-second PAM-4, with future

expansion to 56-gigabit-per-second NRZ. Cabled STRADA Whisper connectors also reduce insertion loss for improved channel margin. Connection options expand if they are not being tied to a circuit board, company officials say. TE offers three main cabled STRADA Whisper solutions: point-to-point cable, value-add assemblies, and a full backplane/midplane solution.

FOR MORE INFORMATION visit **TE Connectivity** online at *www.te.com*.

new PRODUCTS

EMBEDDED COMPUTING

Aitech, ADLINK ruggedize Xeon 3U VPX board for harsh-environment applications

Aitech Defense Systems Inc. in Chatsworth, Calif., and ADLINK Technology Inc. in San Jose, Calif., are working together to ruggedize ADLINK's newest Xeon-based 3U VPX embedded computing blade for use in mission-critical aerospace and defense harsh-environment applications. This partnership brings Aitech's system integration capabilities for rugged, harsh-environment, and military-qualified electronics to ADLINK's range of embedded computing solutions. It also enables Aitech to provide powerful Xeon-based systems tailored to an application's requirements, with different configurations that include user-defined I/O ports, graphics cards, and frame grabbers. Operating in a range of -40 to 75 degrees Celsius in air- and conduction-cooled versions, the 3U VPX single-slot C876 single-board computer serves as the heart of the rugged subsystems and uses the Intel Xeon D-1500 multi-core processor.

FOR MORE INFORMATION visit **Aitech** online at *www.rugged.com*, or **ADLINK** at *www.adlinktech.com*.

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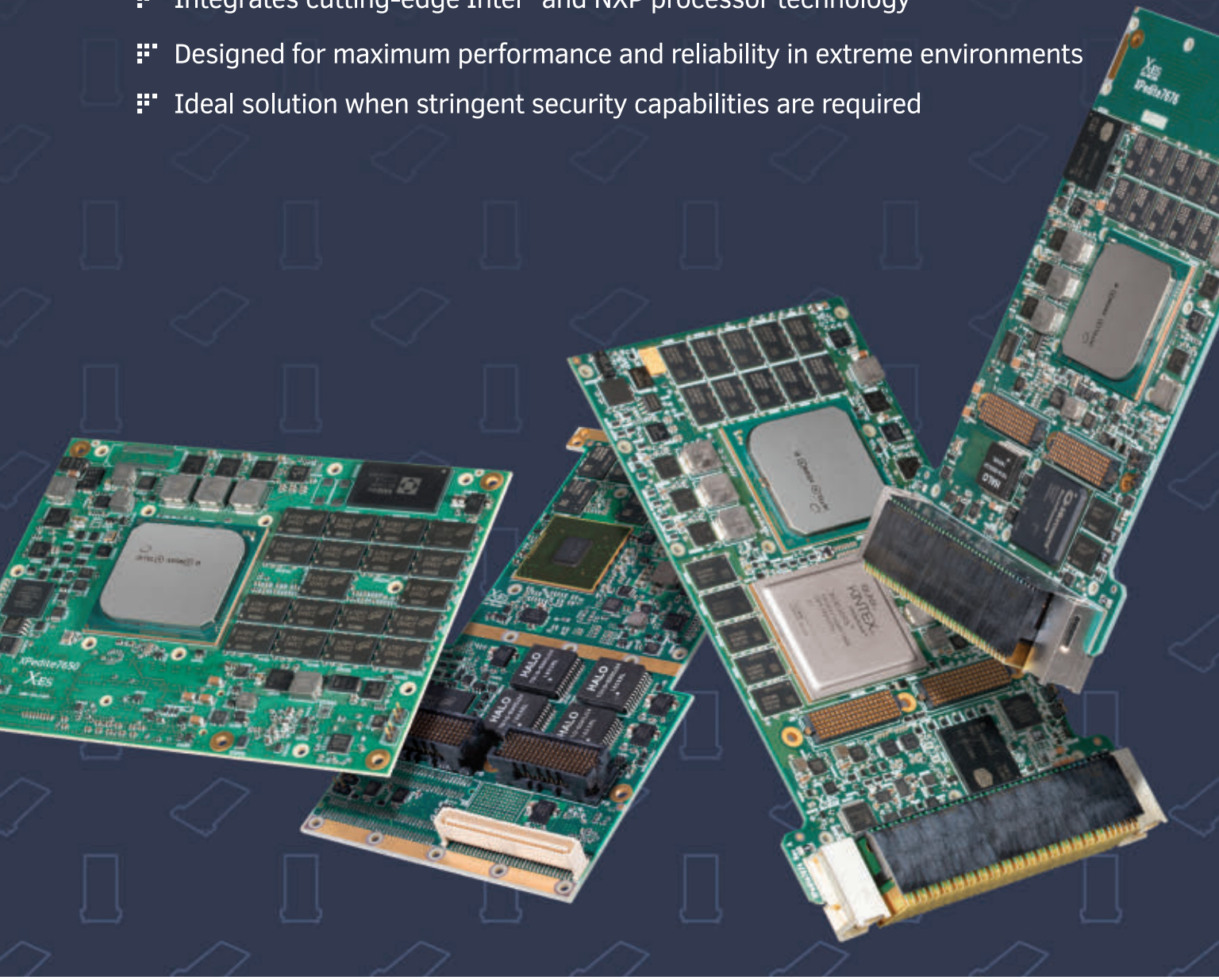

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